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## **Cost-utility analysis of treatment methods in spinal diseases**

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**AIM:** The purpose of the present research study is to evaluate the quality of life of patients with musculoskeletal problems of the Spinal Column before and after surgery with the use of the EQ-5D-5L health status questionnaire.

**MATERIALS - METHODS:** The research is based on primary data collection of 27 patients who completed the questionnaires at three different times: a) preoperatively; that is, after completion of conservative treatment which involved medication, physiotherapy, etc., b) ten days postoperatively and c) immediately after the first post-operative month.

**RESULTS:** Out of the 27 patients, aged between 34 and 79 years (mean age  $52 \pm 15,07$ ) who participated in this study, 11 were males (40,7%) while 16 were females (59,3%). 48,1% of the patients suffered from a herniated intervertebral disc in the lumbar region, 18,5% from symptomatic degenerative disc disease (DDD or black disc), 18,5% from a herniated intervertebral disc in the cervical region and the remaining 14,8% from spondylolisthesis in the lumbar region.

Total improvement of the quality of life (QoL) in our study was on average 0,6 QALYs at 10 days and 0,83 QALYs at 30 days. The total average direct cost of these surgical interventions amounted to 7413,1 $\pm$ 3062,9 while the index of cost-utility for the sample population was estimated to be 12355,2 euro/ QALY at 10 days. This index decreased considerably to 8931,4 euro/ QALY at 30 days after the surgical intervention since the average benefit in QALYs increased and the QoL improved.

**CONCLUSIONS:** The results of the present study point out the great utility of surgical interventions in the spinal column to treat patients' common symptoms (low back pain with or without sciatica) with complications being nearly next to zero. By means of the EQ-5D-5L health status questionnaire, the comparative study of patients' QoL both before and after surgical treatment reveals statistically considerable improvement at 10 and 30 days following the surgery.

Finally, this study has led to useful conclusions: a) the modern technique of discoplasty is rather more efficient than percutaneous spinal fusion for the treatment of lumbago from degenerative disc disease in the lumbar region, b) conservative treatment of spinal column problems is rather less efficient than surgical treatment and c) modern surgery of the spinal column in Greece is rather more efficient than in other modern Health Systems.

**KEY WORDS:** Utility, Cost, Quality of Life, Spinal Column.

## INTRODUCTION

It is known that pain from the spinal column is an extremely debilitating condition associated with extensive use of healthcare services and the cost of treatment in various countries (Smith *et al.*, 2011). Prevalence of spinal pain is expected to continue increasing as the proportion of the population aged over 65 will continue growing dramatically over the next years.

Although a lot of patients with lumbago and/or sciatica can be treated successfully with conservative management, many also finally need surgical treatment when pain is resistant to conservative treatment. Suffice it to say that the percentages of surgical interventions to cope with the problems in the lumbar region of the spinal column have increased by at least 220% over the past two decades (Athiviraham, Wali and Yen, 2011).

However, about 10-40% of the patients who undergo surgery in the lumbar region of the spinal column experience persistent or recurrent pain in the back post-operatively (Smith *et al.*, 2011). Some of them suffer from chronic low back pain which is a difficult and costly situation for health care providers (Athiviraham, Wali and Yen, 2011).

Depending on the etiology, patients with spinal problems may require yet another surgery (revision), especially those who develop pseudarthrosis or stenosis at the same level after the first surgical intervention. For a subset of these patients, who will require revision, the pain in the spinal column may deteriorate further. Regardless of the etiology, revision of lumbar fusion constitutes an ever-growing and costly healthcare-related problem that affects an increasing number of patients in each country.

It should be noted that the prevalence and relative high cost of the health care of the patients who require treatment in the spinal column have aroused interest in the management of this population. Given the estimated increase in spinal surgical procedures and the incidence of diseases which require these, everyone's attention focuses on cost reduction as well as on improving the quality of such procedures (Sigmundsson, 2014).

Even though some studies identify the risk factors, mainly associated with poorer patients, and even though they describe the high cost of surgical interventions in the lumbar region, no studies have been conducted to determine the ratio cost-efficiency in patients that require such surgical treatments in the spinal column.

The present study aims at analyzing the utility of surgical interventions in spinal column diseases such as lumbar herniated disc with or without instability of the spinal column, lumbar stenosis and spondylolisthesis as well as the required cost for such interventions to be carried out at a major private clinic. Ultimate purpose of this study is the comparative analysis of the cost-utility index of surgical treatment to that of conservative treatment of different spine-related diseases.

## **MATERIALS - METHODS**

This research study sets out to evaluate the quality of life (QoL) of patients with musculoskeletal problems of the spinal column before and after surgical treatment through the EQ-5D-5L health status questionnaire. All the participants were patients of a private Neurosurgical office and were operated by a neurosurgeon with a 16-year-old experience in spinal surgery at a major private clinic (Metropolitan Hospital) in Piraeus, Greece.

At the same time the direct cost of these interventions has been recorded so that the cost-utility ratio could be determined for the whole sample of patients and for various subcategories of spinal surgical interventions (percutaneous microdiscectomy, lumbar discectomy, percutaneous lumbar fusion and anterior cervical fusion).

The research is based on data collected from 27 patients who completed the questionnaires at three different time periods. The first occurred preoperatively; namely, after completion of the conservative treatment (medication, physiotherapy, etc), the second 10 days after the surgical treatment and the third one month after the surgery.

Along with the main questionnaire, a supplementary one consisting of 18 closed type questions was completed with the demographics of the patients.

To assess the QoL the EQ-5D-5L questionnaire was used, which is made available for free in Greek by the EuroQol Research Foundation for the purposes of the study (Yfantopoulos, 2001). The questionnaire comprises five questions on the QoL of participants with five different answer choices each, as well as a Visual Analogue Scale (EQ VAS) 20cm in length, with values ranging from 0-100. The combination of all the answers of the questionnaire leads to 3125 possible combinations regarding possible health states. The EQ index value was estimated based on the instructions of the questionnaire user's manual using the algorithm for the population in Spain

since there is no similar algorithm for the Greek population (Van Hout *et al.*, 2012) (Ramos-Goñi *et al.*, 2018).

For the estimation of the cost and billing of surgical interventions in the spine of the patients of our sample, financial data were provided upon request by the accounting office of the private clinic Metropolitan Hospital while the cost of conservative treatment was determined based on the international literature.

## **Statistical Analysis**

In order to determine whether there was statistically significant difference between the responses to the five questions (Mobility, Self-care, Usual activities, Pain/ Discomfort, Anxiety/ Depression) and the overall QoL index (Visual Analogue Scale or VAS score) (with values ranging between 0-100, where 100 corresponds to best health and 0 to worst health) as shown in the self-evaluation questionnaire of the state of health, we used the nonparametric Wilcoxon Signed Rank Test and we compared the patients' mean responses for all variables (6 in total).

More specifically, we compared the patient's state of health in pairs (three pairs at a time) before surgical intervention, at 10 days and at 30 days after surgical intervention for each disease separately. Statistically significant were the results with  $p < 0,05$ .

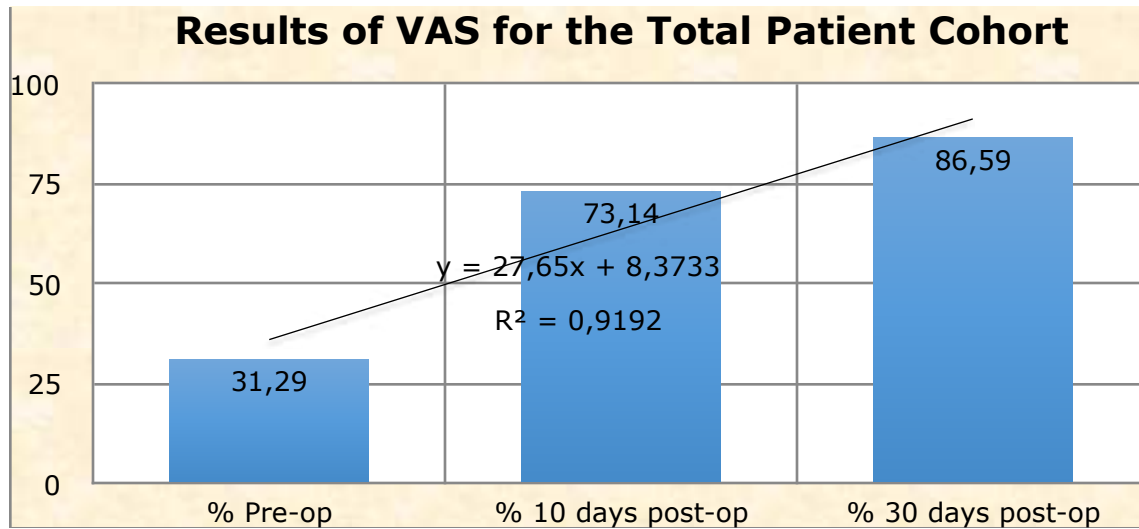
## **RESULTS**

### **Demographics**

A cohort of 27 patients, of whom 11 were men (40,7%) while 16 were women (59,3%), aged between 34 - 79 with the mean age being  $52 \pm 15,07$ , participated in the study. 48,1% of the patients suffered from herniated intervertebral disc in the lumbar region, 18,5% suffered from degenerative disc disease (black disc), 18,5% from herniated intervertebral disc in the cervical region and the remaining 14,8% suffered from spondylolisthesis in the lumbar region.

### **Evaluation of the overall state of health of patients**

On the day of the intervention, each patient recorded his perceived state of health on a 0-100 scale of the questionnaire (Visual Analogue Scale or VAS score) and then he went on to record the number that corresponded to his choice. The mean preoperative score of the 27 patients was  $31,29 \pm 22,17$  but postoperatively it was  $73,14 \pm 13,01$  at 10 days and  $86,59 \pm 12$  at 30 days (Diagram 1).



**Diagram 1:** The patients' QoL preoperatively, 10 days and 30 days after the surgical intervention in the spinal column. Improvement of the QoL postoperatively was evident for the entire sample of patients

### Evaluation of the patients' mobility

The patients selected the appropriate answer choice to the question regarding their mobility not only preoperatively but also at 10 days and 30 days after surgery as shown in **Table 2** below.

MOBILITY	Before surgery	10 days after surgery	30 days after surgery
Total number of patients= 27	N (%)	N (%)	N (%)
1. I have no problems in walking about	3 (11,11)	8 (29,62)	25 (92,59)
2. I have slight problems in walking about	5 (18,51)	15 (55,55)	2 (7,4)
3. I have moderate problems in walking about	4 (14,81)	4 (14,81)	0
4. I have severe problems in walking about	12 (44,44)	0	0
5. I am unable to walk about	3 (11,11)	0	0

**Table 2:** Distribution of the patients' responses regarding their mobility, before and after surgery (at 10 and 30 days)

Subsequently, the patients' responses were classified anchored on a scale from 1-5, according to the user guide with 1 corresponding to 'I have no problems in walking about' and 5 corresponding to 'I am unable to walk about'. The median index for the patient cohort was  $3,25 \pm 1,22$  units before surgery whereas the respective one for 10 days after surgery was  $1,85 \pm 0,66$  units and for 30 days after surgery  $1,07 \pm 0,26$  units.

### Evaluation of the patients' self-care

The patients selected the appropriate answer choice to the question regarding their self-care, not only preoperatively but also at 10 days and 30 days after surgery, as shown in **Table 3** below.

SELF-CARE Total number of patients=27	Before surgery N (%)	10 days after surgery N (%)	30 days after surgery N (%)
1. I have no problems washing or dressing myself	7 (25,92)	15 (55,55)	24 (88,88)
2. I have slight problems washing or dressing myself	1 (3,7)	6 (22,22)	2 (7,4)
3. I have moderate problems washing or dressing myself	5 (18,51)	6 (22,22)	1 (3,7)
4. I have severe problems washing or dressing myself	13 (48,14)	0	0
5. I am unable to wash or dress myself	1 (3,7)	0	0

**Table 3:** Distribution of the patients' responses regarding their self-care, before and after surgery (at 10 and 30 days).

Subsequently, the patients' responses were classified anchored on a scale from 1-5 according to the user guide with 1 corresponding to 'I have no problems washing or dressing myself' and 5 corresponding to 'I am unable to wash or dress myself'. The median index for the patient cohort was  $3,00 \pm 1,33$  units before surgery whereas the respective one for 10 days after surgery was  $1,66 \pm 0,83$  units and for 30 days after surgery  $1,14 \pm 0,45$  units.

### Evaluation of the patients' ability to do their usual activities

The patients selected the appropriate answer choice to the question regarding their ability to do their daily activities, not only preoperatively but also at 10 and 30 days after surgery, as shown in **Table 4** below.

USUAL ACTIVITIES Total number of patients=27	Before surgery	10 days after surgery	30 days after surgery
1. I have no problems doing my usual activities	1 (3,7)	7 (25,92)	20 (74,07)
2. I have slight problems doing my usual activities	3 (11,11)	12 (44,44)	7 (25,92)
3. I have moderate problems doing my usual activities	5 (18,51)	7 (25,92)	0
4. I have severe problems doing my usual activities	14 (51,85)	1 (3,7)	0
5. I am unable to do my usual activities	4 (14,81)	0	0

**Table 4:** Distribution of the patients' responses regarding their ability to do their daily activities, before and after surgery (at 10 and 30 days).

Subsequently, the patients' responses were classified anchored on a scale from 1-5 according to the user guide with 1 corresponding to 'I have no problems doing my usual activities' and 5 corresponding to 'I am unable to do my usual activities'. The median index for the patient cohort was  $3,62 \pm 1,0$  units before surgery whereas the respective one at 10 days after surgery was  $2,07 \pm 0,82$  units and at 30 days after surgery  $1,25 \pm 0,44$  units.

### Evaluation of patients' pain / discomfort

The patients selected the appropriate answer choice to the question regarding pain intensity, not only preoperatively but also at 10 and 30 days after surgery, as shown in **Table 5** below.

Subsequently, the patients' responses were classified anchored on a scale from 1-5, according to the user guide with 1 corresponding to 'I have no pain or discomfort' and 5 corresponding to 'I have extreme pain or discomfort'. The median index for the patient cohort was  $4,22 \pm 0,97$  units before surgery whereas the respective one at 10 days after surgery was  $2,03 \pm 0,70$  units and at 30 days after surgery  $1,29 \pm 0,60$  units.



<b>PAIN/ DISCOMFORT</b> <b>Total number of patients= 27</b>	<b>Before surgery</b>	<b>10 days after surgery</b>	<b>30 days after surgery</b>
1. I have no pain or discomfort	1 (3,7)	6 (22,22)	21 (77,77)
2. I have slight pain or discomfort	0	14 (51,85)	4 (14,81)
3. I have moderate pain or discomfort	4 (14,81)	6 (22,22)	2 (7,4)
4. I have severe pain or discomfort	9 (33,33)	0	0
5. I have extreme pain or discomfort	13 (48,14)	0	0

**Table 5:** Distribution of the patients' responses regarding their pain intensity, before and after surgery (at 10 and 30 days).

### **Evaluation of the patients' anxiety / depression**

The patients selected the appropriate answer choice to the question regarding their anxiety / depression, not only preoperatively but also at 10 and 30 days after surgery, as shown in **Table 6** below.

<b>ANXIETY/ DEPRESSION</b> <b>Total number of patients=27</b>	<b>Before surgery</b> <b>N (%)</b>	<b>10 days after surgery</b> <b>N (%)</b>	<b>30 days after surgery</b> <b>N (%)</b>
1. I am not anxious or depressed	5 (18,51)	13 (48,14)	23 (85,18)
2. I am slightly anxious or depressed	0	8 (29,62)	2 (7,4)
3. I am moderately anxious or depressed	6 (22,22)	4 (14,81)	1 (3,7)
4. I am severely anxious or depressed	7 (25,92)	1 (3,7)	1 (3,7)
5. I am extremely anxious or depressed	9 (33,33)	1 (3,7)	0

**Table 6:** Distribution of the patients' responses regarding their anxiety and depression, before and after surgery (at 10 and 30 days).

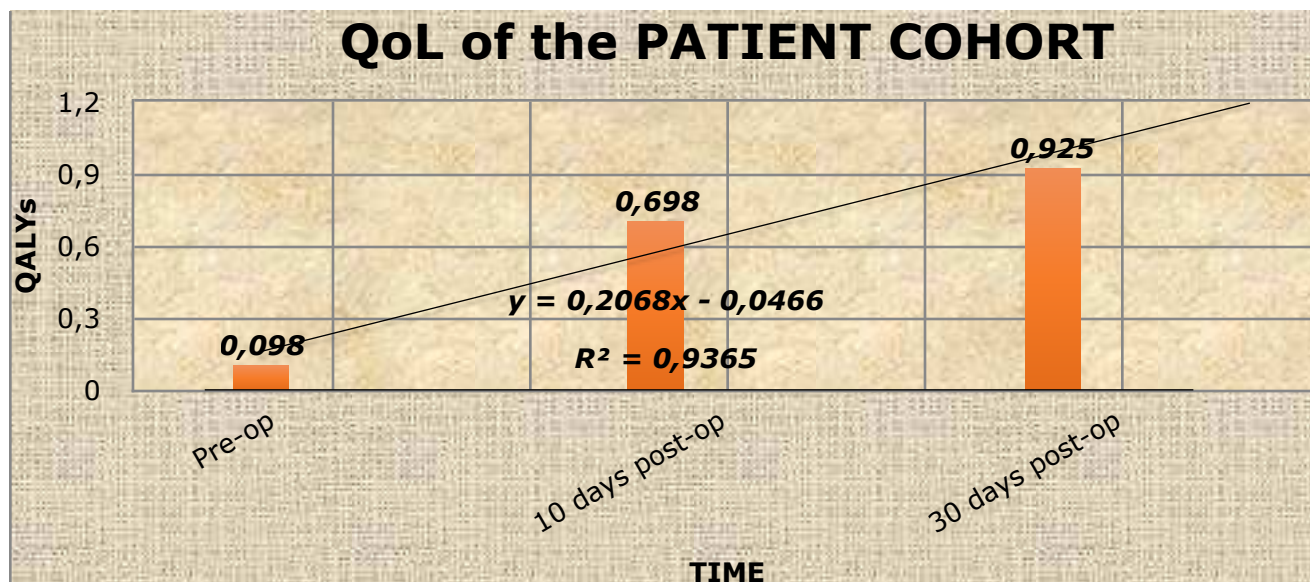
Subsequently, the patients' responses were classified anchored on a scale from 1-5, according to the user guide with 1 corresponding to 'I am not anxious or depressed' and 5 corresponding to 'I am extremely anxious or depressed'. The median index for the patient cohort was  $3,55 \pm 1,45$  units before surgery whereas the respective one at 10 days after surgery was  $1,85 \pm 1,06$  units and at 30 days after surgery  $1,25 \pm 0,71$  units.

### **Evaluation of the patients' quality of life**

The average QoL of the 27 patients before the surgical intervention was  $0,098 \pm 0,35$  units. The median index before surgery, at 10 days and at 30 days after surgery was 0,006, 0,711 and 1 respectively. The above-mentioned data are recorded in details in **Table 7** and in **Diagram 2**.

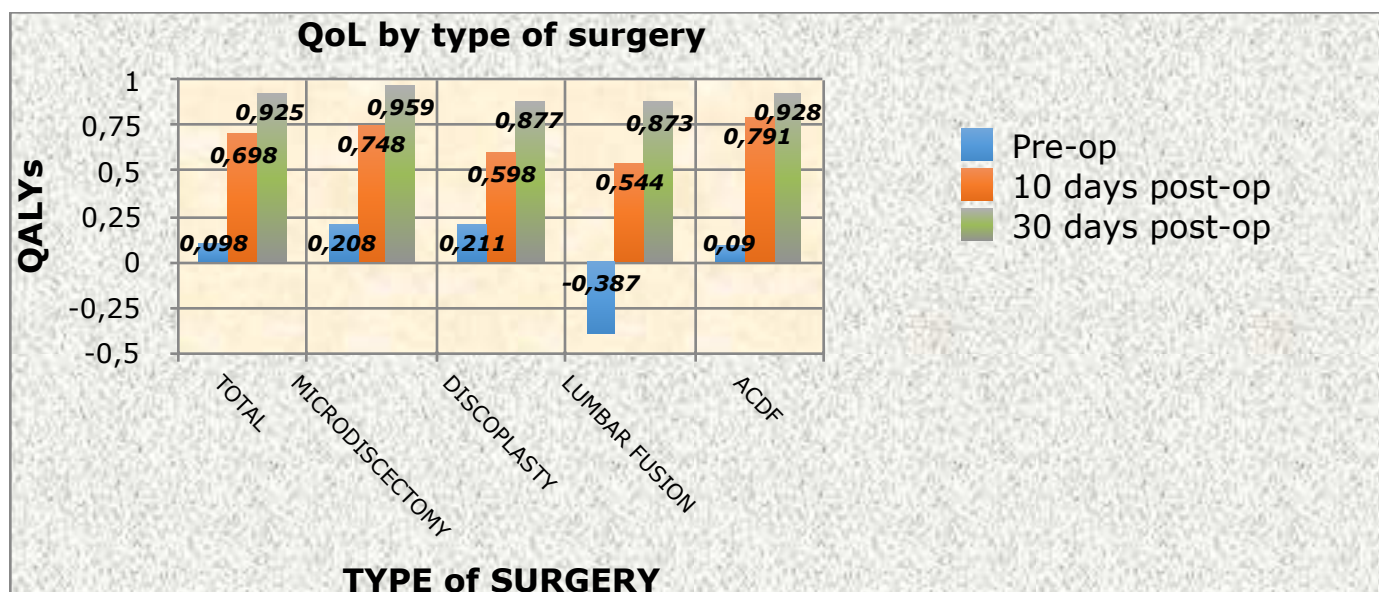
<b>EQ-5D-5L index value</b>	<b>Total number of patients</b>	<b>Mean value</b>	<b>Standard deviation or error</b>	<b>Median value</b>	<b>Minimum</b>	<b>Maximum</b>
Before surgery	27	0,098	0,35	0,006	-0,654	0,818
10 days after surgery	27	0,698	0,16	0,711	0,294	0,910
30 days after surgery	27	0,925	0,12	1	0,585	1

**Table 7:** The QoL of the patient cohort before the surgical intervention as well as at 10 and 30 days after the surgical intervention in the spinal column.



**Diagram 2:** Improvement of the QoL of the patient cohort after the surgical intervention both at 10 and at 30 days.

The gain in QALYs is shown in detail in **Diagram 3** as that was estimated for the patient cohort but also for each subset of the patients in the study. Improvement of the level of QoL postoperatively was evident in all subsets of patients of the sample.



**Diagram 3:** The QoL of the patients preoperatively, 10 days and 30 days after the surgical intervention in the spinal column, by type of surgery.

## Medical Billing

In 2002 a list of the maximum sums of money that can be allocated to a state hospital for all possible types of hospitalization and treatment was enacted. This list, which is the equivalent to the American DRGs (Diagnosis Related Groups), is known in Greek as K.E.N. ‘Closed Consolidated Medical Bills’ and is valid – after having been updated - as of March 2012 (Government Gazette 946/ 27).

Private clinics, like the Metropolitan Hospital, are reimbursed either by the National Organisation for the Provision of Health Care Services (E.O.II.Y.Y.) based on the Closed Consolidated Medical Bills (K.E.N) or by private insurance companies with which a contract has been signed, as long as the patient has got a private health insurance policy. When the reimbursement is paid by E.O.II.Y.Y., then the clinic receives 70% of the sum as per K.E.N while the remaining 30% of the sum is paid by the patient himself (out-of-pocket payment). Moreover, the patient who is operated at a private clinic is to pay doctors’ fees; namely, the surgeon’s and his assistant’s fees as well as that of the anesthesiologist.

Type of surgical procedures	Number of patients	70% KEN E.O.II.Y.Y	Private health insurance (hospitalization + materials)	Private payment *	Medical fees	Total average direct cost at a private clinic in 2018 in euro ±SD
Discoplasty	5	786,1	3424,4±822,8	1672,2±785,7	1129,2±413,3	5840,5±964,5
Microdiscectomy or microdecompression	13	786,1	4929,6±1431,6	1653,1±1096,7	3167,0±1069,5	7523,7±3120,8
Anterior Cervical Decompression and Fusion (ACDF)	5	2539,6	3697,1±450,4	2000	2488,2±1043,5	7192,5±1211,0
Lumbar spinal fusion	4	4200	8849,3	2029,4	2952,5±1347,0	11067,3±7166,3
Total sample	27	1616,5	4578,4±1787,5	1741,6±1124,1	2611,5±1229,7	7413,1±3062,9

\* Under the category of Private Payments are only included the sums paid by patients for hospitalization and materials and not for the medical fees - entered under medical fees - that the patients themselves or their private insurance companies pay.

**Table 8:** Total average direct cost per surgical procedure in the spine for the cohort of the sample at a private clinic in Athens, in 2018.

Microdiscectomy reimbursement was determined after having taken into account the lowest K.E.N. whose billing by E.O.II.Y.Y. is coded M10xδ ‘Other surgical interventions in the spine without co-existing serious conditions or complications, or Halo traction without complicated interventions’.

## DISCUSSION

The results of the present study indicate the high effectiveness of surgical interventions in the spinal column for the treatment of patients' basic symptoms (low back pain with or without sciatica) with a close to zero percentage of complications. In nearly all statistical trials of the sample, statistically important improvement in all variables of the EQ-5D-5L questionnaire has been noticed at both 10 and 30 days after the surgical intervention and consequently improvement in their overall QoL. The combination of high effectiveness and low percentage of complications can be attributed, on the one hand, to the considerable expertise and experience of the medical and paramedical members of staff and, on the other hand, to the high technology utilized during image-guided surgery (C-arm, O-arm, and Neuronavigation). The Minimally Invasive Techniques, the surgical microscope and the surgical microinstruments which were utilized ensured zero intraoperative and postoperative complications and eliminated the need for blood transfusion. Careful selection of all patients after taking a detailed history, thorough neurological clinical examination and evaluation of all imaging findings led to reducing hospital length of stay. More specifically, one-day surgery for discectomy, less than 48-hour - hospitalization for microdiscectomy in the lumbar region and anterior cervical discectomy and fusion in the cervical region (ACDF) and 48-hour hospitalization for spinal fusion in the lumbar region.

The current financial analysis was conducted for four specific surgical interventions in the spinal column of patients treated at a private clinic, from the perspective of society as a whole, without including medical fees which are considered limited and variable and therefore difficult to calculate since there is no collective bargaining agreement in place for those working at private clinics and the terms and conditions of employment at the private clinics vary greatly. Moreover, the number of participants in a surgical procedure in the spinal column is not always the same. As for the cost for medical fees this is regarded as negligible compared to the estimated direct cost for interventions and it does not affect the total cost considerably. This cost which was calculated for the private sector in 2016 and for at least four members of staff (i.e. a surgeon, an assistant surgeon, an anesthesiologist and an anesthesiologist assistant) amounted to 125 euro per hour.

Bibliographical data show that lumbar spinal fusion, in USA in 2008, was associated with 0,23 benefit in QALYs and cost-utility index \$ 115.600 / QALY two years after surgery while lumbar microdiscectomy was associated with 0,21 benefit in QALYs and cost-utility index \$ 34.355 / QALY at the same postoperative point (Tosteson *et al.*, 2008) (Weinstein *et al.*, 2014). The cost-utility index for lumbar spinal fusion four years after surgery dropped to \$ 64.300 / QALY because of the gradual improvement in patients' QoL. Since improvement in patients' QoL is expected in theory after surgical intervention in the spinal column over time, as documented in

international studies (Tosteson *et al.*, 2011), a further reduction in cost-utility indices that were measured on 30<sup>th</sup> postoperative day is expected. Consequently, the cost-utility index for lumbar spinal fusion during the 4<sup>th</sup> postoperative year in USA in 2008 which corresponds to an index of € 65.046 / QALY in 2018 will be 5,8 times higher than the same index during the 1<sup>st</sup> postoperative month in Greece in 2018! From the above mentioned it is, therefore, clear that the Greek Medical Tourism, modern Private Health Care and by extension modern Greek economy have got a great competitive benefit at least in the field of costly surgeries of the spinal column, over other advanced economies like that of the USA.

The comparative study of the cost-utility indices has also revealed that discoplasty has a better index than lumbar spinal fusion on 30<sup>th</sup> postoperative day even though it is the other way round on 10<sup>th</sup> day. (**Table 9**) This means that the specific method should be preferred for the treatment of degenerative disc disease over lumbar spinal fusion which constituted the only method of treatment for the specific health problem in the past. This topic needs to be studied over time so that the length of the effectiveness of this new method can be confirmed as well as its long-term utility.

The cost-utility index of conservative treatment for the symptoms of the patients who underwent surgical treatment was not possible in the present study. Consequently, there are no data for the comparison of the two treatments; namely, the conservative treatment and the surgical one for the very same problems in the spine within the same sample of population. For this reason, bibliographical data for the evaluation of this index were searched. A systematic overview (Lin *et al.*, 2011) of the studies for the measurement of the cost-utility index reveals that the index amounted to GBP 2.847-34.473 / QALY (In sterling pounds (GBP) in 2005), depending on the type of conservative treatment that was utilized (family doctor consultation, workout, massage, acupuncture, chiropractic, physiotherapy, the Alexander Technique etc.) with massage being the most expensive and the least effective of all. Conversion of these sums into current values (June 2018) corresponds to cost-utility index that ranges between GBP 4.128,85 - 49.994,36 / QALY whereas conversion of pounds into euro gives us values that range between € 4.682 and 56.693 / QALY. Comparison of the cost-utility indices between surgical treatment and conservative treatment for the problems in the spinal column shows that conservative treatment may range from 0,5 - 6,3 times the cost of surgical treatment for the same diseases in Greece in 2018!

Further study between the cost-utility index of surgical treatment for problems in the spinal column and the respective index of less invasive treatments like percutaneous infusions (epidural infusion, infusion in the facets of the spinal column or infusion in sacroiliac joints) shows that even though infusions are much cheaper ( € 460,59 / QALY in the private sector in Greece in 2016 including fees), they have a short-term favorable outcome for the patient (usually the

maximum effect lasts for a month and then the complaints gradually recur) (Civelek *et al.*, 2012) (D'Orazio, Gregori and Gallucci, 2015).

At this point it is worth pointing out that the measurement of the cost-utility index was deliberately based solely on patients operated at a private clinic and not at a public hospital since 'hidden payments' are not a case of the past in the field of Public Health even today after eight years of financial crisis in Greece and that would constitute a major error factor which would render any comparison between private and public expenditure unreliable.

Other limitations of the present study are the small number of subjects that participated in it (27 patients) and the absence of comparative patient groups that underwent other types of treatment; for instance, conservative treatment or percutaneous infusions. Furthermore, evaluation of the outcomes was carried out over a short period of time; namely, at 10 and 30 days postoperatively. Another drawback of the study is that even though the patients themselves were used as control group who filled out the questionnaire preoperatively, in other words immediately after conservative treatment, which enables us to evaluate the effectiveness of conservative treatment, the type and cost of conservative treatment were not recorded so that the index of cost-utility of conservative treatment could be measured and a more realistic comparison between the indices of surgical treatment and conservative treatment could be made.

Finally, as far as the evaluation of the cost of surgical interventions in the spinal column is concerned, it is worth mentioning that the direct non-medical costs such as the patients' transport and the cost of a carer were not included neither were any indirect costs from loss of productivity of the patients themselves or of their relatives during rehabilitation. In any case these costs either influence all categories of patients uniformly or are limited since the surgical treatments used were Minimally Invasive Techniques which do not require lengthy rehabilitation and all the patients of the sample are able to do everything by themselves from day one after surgery.

## **CONCLUSIONS**

The findings of the present study being recorded meticulously lead us to some useful conclusions.

The surgical treatment of common diseases of the spinal column such as herniated lumbar and cervical discs, degenerative disc disease and spondylolisthesis is highly effective and has practically zero percentage of complications during the early postoperative phase; that is, during the first postoperative month.

Monitoring these patients by means of their completion of the EQ-5D-5L health status questionnaire is particularly revealing since it facilitates the measurement of the gain in QALYs

and consequently of these patients' level of health improvement. The concurrent cost evaluation of such surgical interventions enables us to calculate cost-utility indices for these surgical treatments as well as compare these treatments to one another or to other conservative treatments or to other treatments like infusions.

Hence, it has been ascertained that surgery of the spinal column in Greece nowadays is highly effective compared to the same treatment in other modern healthcare systems.

The revelation concerning conservative treatment of problems in the spinal column being somewhat less effective than surgical treatment in general is sensational.

Finally, it is worth mentioning that the modern technique of discoplasty is rather more effective than percutaneous spinal fusion for the treatment of lumbago in the context of degenerative disc disease in the lumbar region.

Further research in this scientific field, with a larger number of patients, may convince both the medical community and society as a whole, that early surgical treatment of the problems in the spinal column is more effective and more useful than conservative treatment and may also contribute to the change in present mentality which dictates the use of all non-surgical treatment options before resorting to surgical treatment because this approach renders the problems very expensive for the healthcare system.

In this way resources will be conserved that may contribute to resolving other health problems of the general population which are likely not to be addressed adequately due to a lack of sufficient resources.



## REFERENCES

- Athiviraham, A., Wali, Z. A. and Yen, D. (2011) 'Predictive factors influencing clinical outcome with operative management of lumbar spinal stenosis', *Spine Journal*, 11(7). doi: 10.1016/j.spinee.2011.03.008.
- Civelek, E. *et al.* (2012) 'Comparison of effectiveness of facet joint injection and radiofrequency denervation in chronic low back pain', *Turkish Neurosurgery*, 22(2). doi: 10.5137/1019-5149.JTN.5207-11.1.
- D'Orazio, F., Gregori, L. M. and Gallucci, M. (2015) 'Spine epidural and sacroiliac joints injections. When and how to perform', *European Journal of Radiology*, 84(5). doi: 10.1016/j.ejrad.2014.05.039.
- Van Hout, B. *et al.* (2012) 'Interim scoring for the EQ-5D-5L: Mapping the EQ-5D-5L to EQ-5D-3L value sets', *Value in Health*, 15(5). doi: 10.1016/j.jval.2012.02.008.
- Lin, C. W. C. *et al.* (2011) 'Cost-effectiveness of general practice care for low back pain: A systematic review', *European Spine Journal*. doi: 10.1007/s00586-010-1675-4.
- Ramos-Goñi, J. M. *et al.* (2018) 'Handling Data Quality Issues to Estimate the Spanish EQ-5D-5L Value Set Using a Hybrid Interval Regression Approach', *Value in Health*, 21(5). doi: 10.1016/j.jval.2017.10.023.
- Sigmundsson, F. G. (2014) 'Determinants of outcome in lumbar spinal stenosis surgery', *Acta Orthopaedica*, 85(sup357). doi: 10.3109/17453674.2014.976807.
- Smith, J. S. *et al.* (2011) 'Risk-benefit assessment of surgery for adult scoliosis: An analysis based on patient age', *Spine*, 36(10). doi: 10.1097/BRS.0b013e3181e21783.
- Tosteson, A. N. A. *et al.* (2008) 'Surgical treatment of spinal stenosis with and without degenerative spondylolisthesis: Cost-effectiveness after 2 years', *Annals of Internal Medicine*, 149(12). doi: 10.7326/0003-4819-149-12-200812160-00003.
- Tosteson, A. N. A. *et al.* (2011) 'Comparative Effectiveness Evidence from the Spine Patient Outcomes Research Trial', *Spine*, 36(24). doi: 10.1097/brs.0b013e318235457b.
- Weinstein, J. N. *et al.* (2014) 'The SPORT value compass: Do the extra costs of undergoing spine surgery produce better health benefits?', *Medical Care*, 52(12). doi: 10.1097/MLR.0000000000000250.
- Yfantopoulos, J. (2001) 'The Greek version of the EuroQol (EQ-5D) instrument', *Archives of Hellenic Medicine*, 18(2).